face by capillarity, at once begin to lose carbon dioxid, leaving a residue of sesquicarbonate; which will, without difficulty, dissolve the humus of the soil, and act in other respects precisely like the normal carbonate.

In view of the fact that the air of the soil always contains more carbonic dioxid than the air, any sodic carbonate it contains in solution will inevitably suffer transformation into bicarbonate to the extent to which carbonic acid happens to be found in the soil under the existing conditions of vegetable growth, temperature, moisture, and bacterial action in the oxidation of organic matter. It is a matter purely of seasonal accident; so that, if a soil sample happens to be taken at a time when carbon dioxid is abundantly forming, the chemist may find in it exclusively bicarbonate; while similar samples, taken a few weeks afterwards, may under the influence of aeration and drying, be found to contain, in the main, the sesquicarbonate.

I have therefore considered, and do now consider, the determination of *sodium bicarbonate* in the soils as quite immaterial for practical purposes, it being a variable and entirely uncertain factor; and inasmuch as ultimately the entire amount of sodic carbonates may serve for the formation of sesquicarbonate and the normal salt, I have thought best to calculate the entire amount of these carbonates found to the latter salt, without reference to the other two.

Of late, the official characterization of the hydrocarbonate salt as no more harmful than other white alkali, has led some chemists analyzing irrigation waters to recommend for that purpose, waters containing considerable amounts of sodium bicarbonate. In this case, the prospect of the accumulation of indefinite amounts of black alkali in the soil irrigated would be such a positive and inexcusable detriment, that it seems high time to put an end to the misleading statement which leads chemists, as well as farmers, to expose lands to serious injury.

E. W. Hilgard

Berkeley, Cal.,
June, 1911

METALS ON METALS, WET

It is generally agreed that the coefficient of friction between metals (outside the physical laboratory) is a very elusive quantity. It is with the hope of suggesting some considerations not mentioned by Professor Hall[1] but of great practical importance that the following comments are offered.

The difference in coefficient of friction between driving wheel and rail, whether the latter is wet or dry, is relatively immaterial so far as the effect of using sand to prevent the slipping of the driving wheels is concerned. Sand is used on dry as well as wet rails, with a similar result in either case, namely, to increase the coefficient of friction between wheel and rail. The reason for this is obvious, since the sand particles become ground between the two surfaces, giving them, in effect, the roughness which greatly increases the coefficient of friction over that of the unsanded smooth surfaces.

It is also well known to railroad engineers that a cleanly washed wet rail, as after a heavy rain, is a "better" rail and is less likely to result in slipping of wheels than a perfectly dry rail. Of course a rail having slimy water or any foreign matter, such as coal dust, frost, etc., which can act as an ungent, results in lowering the coefficient of friction. It is because a wet rail is ordinarily greasy that sand is commonly used when the rail is wet, whereas, a dry rail is more apt to be gritty, due to the dust, etc. There is therefore less necessity for using sand.

Referring to Professor Hall's paragraph one, would not term "adhesion"[2] apply to the phenomena mentioned more accurately than term "friction"? A similar effect is noticed when a thin film of water separates two plates of glass.

Professor Hall's conclusion would seem to satisfactorily account for one phase of the problem, but, as stated above, the phenomenon

[1] Science, May 19, 1911, p. 775.

[2] See DuBois, "Mechanics of Engineering," Vol. 1, p. 220.

of friction, especially as it is met with in actual practise, is a most complex and elusive factor and in attempting to evaluate its effect or satisfactorily account for its mutations it is not safe to overlook any of the possible influences affecting the final results.

Since 1878 it has been known that Morin's laws regarding friction are absolutely unreliable except within a limited range of conditions. With heavy unit pressures between contact surfaces, such as exist over the small area of contact between driving wheel and rail or between a brake shoe and the wheel to which it is applied with the forces required to stop a modern passenger car under present-day service conditions within a reasonable distance, the coefficient of friction may fluctuate through wide ranges, due to the combined influence of pressure, relative speed of contact surfaces, temperature, continued rubbing and so on. For example, with cast-iron brake shoes on steel-tired wheels the effect of speed has been found to reduce the coefficient of friction from 33 per cent. when just moving, to less than 10 per cent. when at a speed of 60 miles per hour.

This subject is far too broad to warrant further discussion in such a communication as this, but any who may be interested in the experimental results obtained, and the conclusions drawn therefrom, are respectfully referred to papers presented before the British Institute of Mechanical Engineers, June and October, 1878, and April, 1879, by Captain Douglas Galton, describing the classic Westinghouse-Galton experiments on the effect of brakes on railway trains and a paper by Mr. R. A. Parke, in the *Railway Gazette* for June 14–21, 1901, entitled "Friction of Brake Shoes." Copies of the above will be gladly furnished gratis on application to the Westinghouse Air Brake Company, Wilmerding, Pa.

S. W. DUDLEY

QUOTATIONS

ADMISSION TO HARVARD COLLEGE

THE new alternative plan of admission to Harvard College, announced to the schools only a few months ago, was given its initial test at the entrance examinations of last week. The results, so far as one may judge at this early date, were in every way distinctly promising. Over one hundred candidates for admission took advantage of the new provisions, which seems to warrant a belief that the schools already realize the possibilities of the scheme as a method of getting their best pupils into Harvard, and that if this year's results prove satisfactory the number of applications for entrance under the alternative arrangements will show a large increase next year.

Even more significant, moreover, is the fact that of these hundred candidates more than half are from schools outside New England. It was precisely to this constituency—the public high schools outside New England—that the new plan was meant to be of service. It was devised primarily as a means of admitting to Harvard bright boys from distant schools who had pursued good four-year preparatory courses, but who had not been hammered into the particular grooves marked out by the old entrance requirements. The schools of New England, whether public or private, find no very great difficulty in meeting these requirements, and many of them, doubtless, will continue to send their boys along the old route. But the public high schools of the middle states, the west and the south have hitherto found the task of fitting boys for Harvard to be much more difficult, and it was to them that the framers of the new admission plan hoped to afford relief. These schools have responded in the most encouraging fashion at the very outset.

It will not, of course, be possible to draw any definite conclusions concerning the quality of the students admitted under the new requirements until they have passed a year or two in the college, side by side with students who have come to us under the old provisions; but the testimony of those who have been reading the examination books indicates that there is every ground for optimism in this